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Comparison of a Free-Breathing CT and an Expiratory Breath-Hold CT with Regard to Spatial Alignment of Amplitude-Based Respiratory-Gated PET and CT Images

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Abstract

Respiratory motion during PET has a significant effect on the quantification of radiotracer uptake in PET images. Even when respiratory motion is considered using PET gating techniques, inaccuracies in standardized uptake values can be caused by inappropriate attenuation correction due to a spatial mismatch between PET and CT. In this study, the effect of breath-hold CT imaging on the spatial match between CT and amplitude-based respiratory-gated PET images is investigated. **Methods:** Whole-body ¹⁸F-FDG PET/CT imaging was performed in 52 patients with 125 lung lesions. ¹⁸F-FDG PET was performed using optimized, amplitude-based respiratory gating. For CT, 36 patients were randomly assigned to the free-breathing (FB) group and 16 to the rest-expiratory breath-hold (BH) group. Spatial mismatch between the PET and CT images was quantified by measuring the distance between the centroids of PET and CT lesions and calculating the Jaccard similarity coefficient (JSC). **Results:** In the upper lobes, the average distance between the centroids of the PET and CT lesions was 4.7 ± 3.1 and 6.0 ± 3.0 mm for the

FB and BH groups, respectively ($P = 0.11$). For the middle and lower lobes, the distances were 5.8 ± 4.3 and 5.1 ± 2.9 mm ($P = 0.70$), respectively, and for the central region 4.8 ± 4.6 and 5.6 ± 2.0 mm ($P = 0.24$), respectively. The JSC for the upper lobes was 0.28 ± 0.17 and 0.28 ± 0.19 , for the FB and the BH group, respectively ($P = 0.83$). For the middle and lower lobes, the JSC was 0.22 ± 0.16 and 0.28 ± 0.18 ($P = 0.20$), respectively, and for the central region 0.39 ± 0.17 and 0.13 ± 0.04 ($P = 0.04$), respectively. **Conclusion:** Providing breathing instructions to the patients during the CT acquisition did not improve the spatial alignment between the respiratory-gated PET images and the CT images. The difficulty experienced in using this clinical protocol, such as patient compliance and operator dependence, emphasizes the need for other strategies.